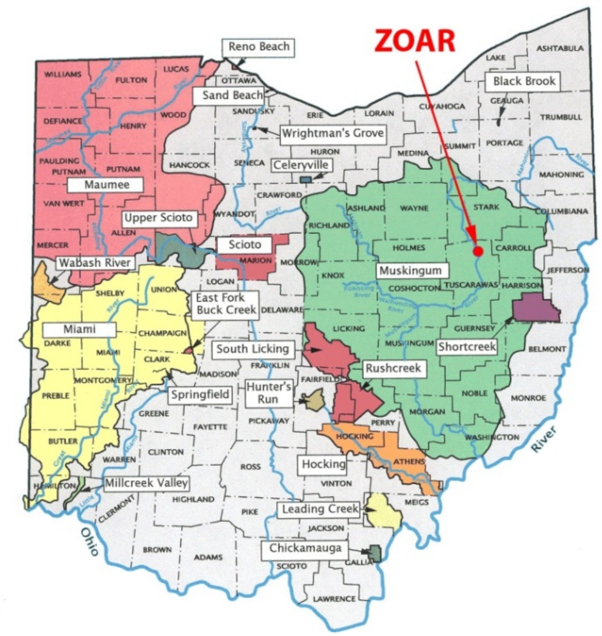
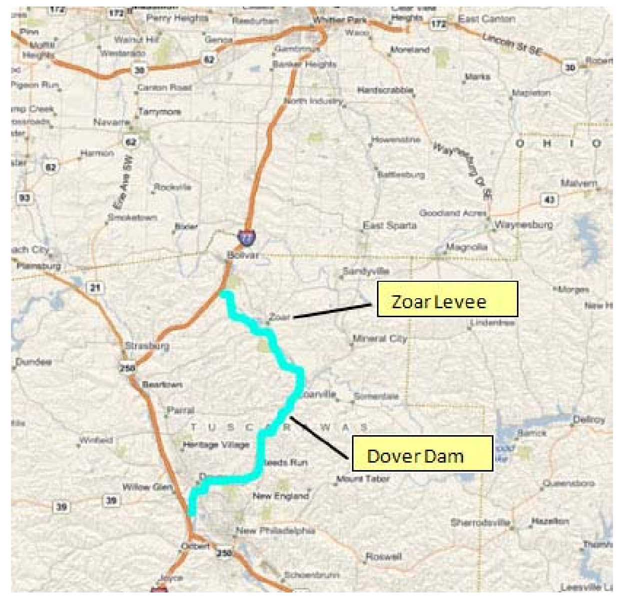
US Army Corps
of Engineers
Huntington District



Zoar Levee & Diversion Dam are located in the Muskingum River Basin highlighted in green to left. The Muskingum River Basin is the site of Ohio's first multiple purpose water management and land conservation river basin project. The Muskingum Watershed Conservancy District (MWCD) was created on 3 June 1933 for the purpose of development this project. The initial plan called for 14 flood control reservoirs. In 1933, the Public Works Administration (PWA) awarded a grant of $22,090,000.00 to the U.S. Army Corps of Engineers to construct the proposed plan. In 1934, the Federal Government executed a contract with the MWCD to allow the U.S. Army Corps of Engineers to conduct investigations and draft a final plan. This official plan for the basin was approved by the MWCD on 19 November 1934. Construction of the project began in 1935 and the completed system was turned over to the MWCD in 1938.



The Flood Control Act of 1939 returned the dams to the federal government and flood control operations back to U.S. Army Corps of Engineers, Huntington District. Zoar Levee & Diversion Dam are part of the Dover Dam project, which is located on Tuscarawas River, just upstream of New Philadelphia and Dover Ohio. Zoar Levee & Diversion Dam are located approximately four miles upstream of Dover on the Tuscarawas River. Dover Dam is a dry dam and retains water, called "pools" only when required to help reduce downstream flooding in coordination with other Muskingum Basin projects. Zoar Levee & Diversion Dam help project Zoar Village from being impacted by Dover Dam's pools.

Today, Zoar Levee & Diversion Dam is a Dam Safety Action Classification I (DSAC I) Project, as progression toward failure may have begun. To remedy the risk the project has, the U.S. Army Corps of Engineers has implemented several measures to reduce the risk and is completing a Dam Safety Modification Study to find the best way to manage the risk long-term.

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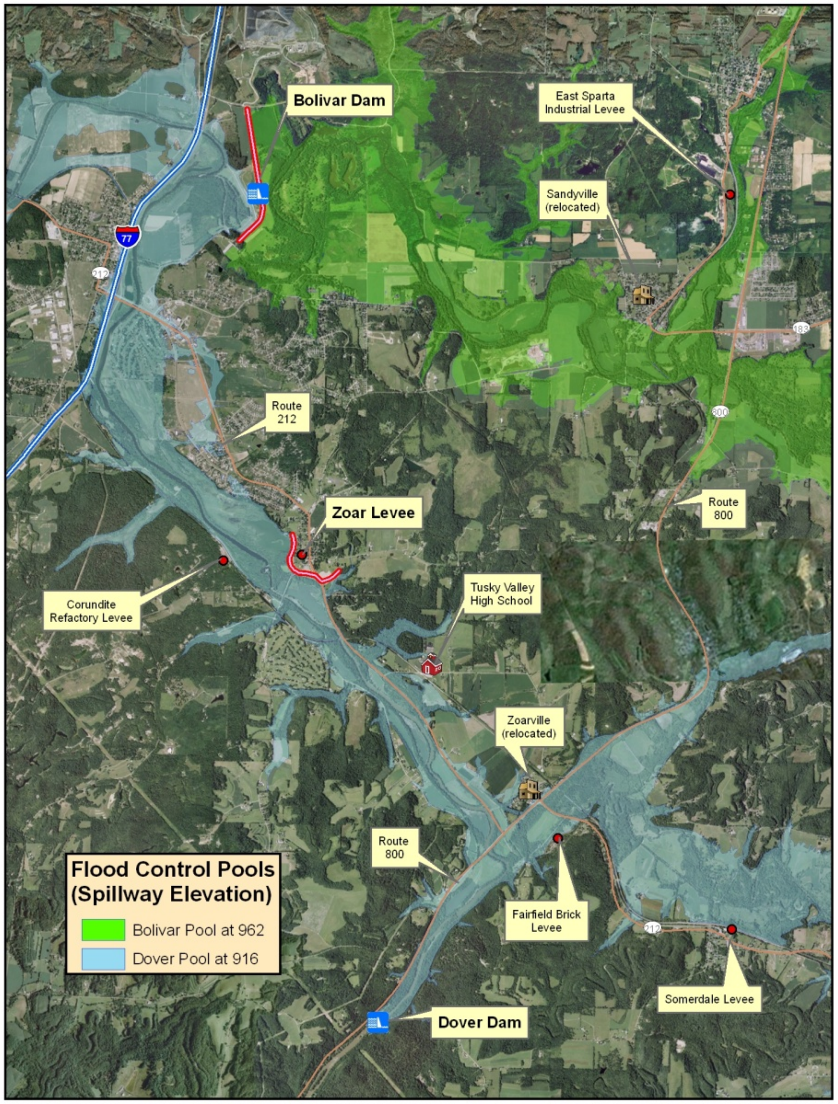
To the right is a picture of water impounded to elevation 907.4 feet in January 2005 behind Dover Dam. This represents the highest water has ever been held behind Dover Dam and is referred to as the “Pool of Record”. The middle part of the dam is called the spillway or the portion of the dam that is designed to be overtopped. The spillway is located at elevation 916 feet.



The federal Government restricts development below elevation 916 feet upstream of Dover Dam so that water can be impounded without damaging property. This is accomplished by a “flowage easement”, which is charted in blue on the map to the left.

Zoar Levee & Diversion Dam were built to help protect Zoar Village from waters being held behind Dover Dam along the Tuscarawas River. Under normal conditions, this river passes through Dover Dam and there is not a lake behind the dam. However, when the gates at Dover are closed, water impounds behind it. If it were not for Zoar Levee & Diversion Dam, much of Zoar Village would have been purchased as it is located below elevation 916 feet. Another U.S. Army Corps of Engineers project, Bolivar Dam, is located upstream of Zoar Levee. Like Dover Dam, it only retains water when required. When filled to its spillway hieght of elevation 962 feet, the areas in green above are also under water. Dover Dam’s flowage easement backs up to the downstream toe of Bolivar Dam, which displays how these projects work together to help relieve flooding downsteam.

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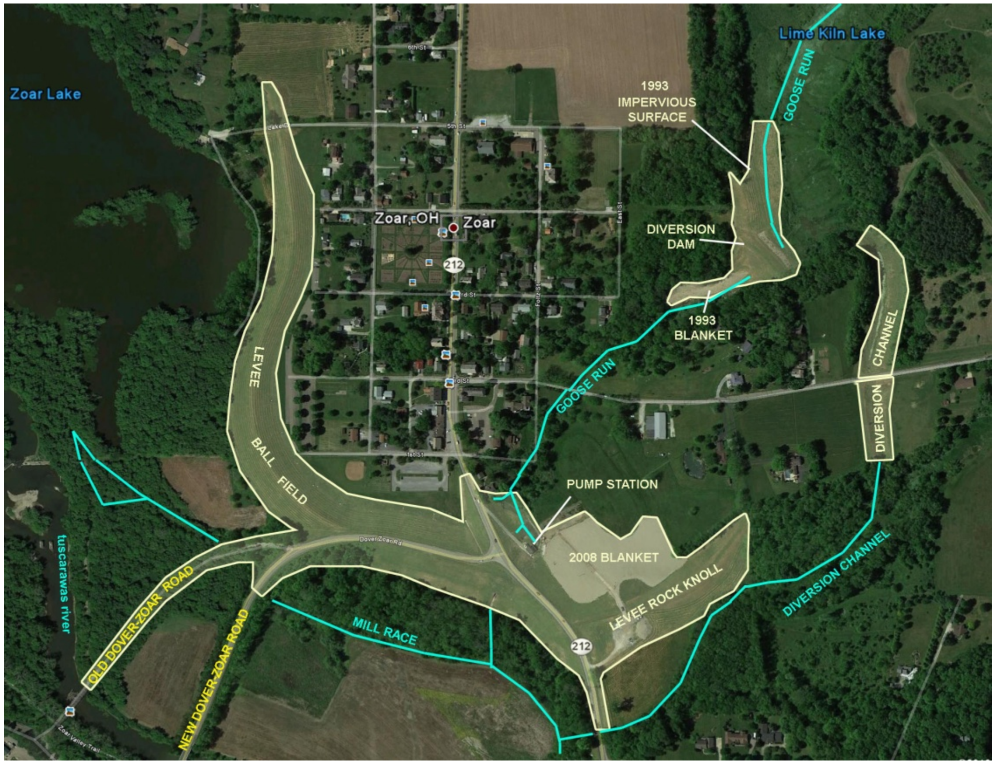

This an aerial photograph of Zoar Levee & Diversion Dam. The levee is generally divided into two reaches. The "Ball Field" side is located on the west side of Route 212 and is named for the little league baseball field located here. This portion of the levee is founded on approximately 130 feet of sands and gravels that allow water to move under the levee which can cause concern about the long-term stability of the project. The "Rock Knoll" side is located on the east side of Route 212 and is named for a localized bedrock high point that extends upward to near the base of the levee. However, this bedrock has several voids that allow water to seep through it and can also cause stability problems.

The diversion dam is located on Goose Run and was built to help control interior flooding in Zoar Village. The diversion dam is founded on and next to the same type of bedrock as the Rock Knoll. It once impounded a permanent lake, but now it only impounds water behind it when required to. The diversion channel is for overflow water to keep the diversion dam from being overtopped. Other features of the project include a pump station located where Goose Run meets Zoar Levee. Under normal circumstances, Goose Run flows underneath the levee before joining an old mill race and proceeding to the Tuscarawas River. However, when Zoar Levee is holding back water being retained by Dover Dam, the tunnel that Goose Run flows through must be closed. Once that tunnel is closed, the pump station pumps Goose Run's water up and over the levee in three pipes. It works much like a sump pump. Evidence of two stone blankets installed by the U.S. Army Corps of Engineers, Huntington District can also be seen. The 1993 blanket is located downstream of the diversion dam and was constructed in 1993 to help control water leaking through bedrock in the dam's abutment. This is called "abutment seepage". The same year impervious soil and fabric was also placed on the upstream side of the diversion dam to cover holes where water was leaking. The 2008 blanket is located on the interior side of the Rock Knoll. The 2008 blanket was constructed in March 2008 when large holes, called "boils" opened up. These boils caused concern that the levee could have lost some structural stability due to potential erosion of foundation materials.

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This map demonstrates the amount of Zoar Village that would be located within Dover Dam's flowage easement (elevation 916 feet) if it were not for Zoar Levee & Diversion Dam. To put it another way, all portions of Zoar Village located in the areas highlighted in blue would have likely been purchased and torn down when Dover Dam was constructed if it were not for Zoar Levee & Diversion Dam.

In some instances, communities were purchased when the U.S. Army Corps of Engineers and MWCD constructed Dover Dam as well as other dams in the Muskingum Water Basin. For example, the community of Zoarville was purchased for Dover Dam and the community of Sandyville was purchased for Bolivar Dam. In both instances, these communities re-established themselves on higher ground. Other levees were also constructed upstream of Dover Dam to protect several factories, as well as the community of Somerdale.

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This is a 2012 photograph of the crest of the Ball Field side of Zoar Levee. When it was originally built, the crest of the levee was at elevation 919 feet. In the 1950s, Zoar Levee was raised to its current crest height of elevation 928.5 feet. At its highest point, Zoar Levee is approximately 45 feet high. The levee is approximately 3,893 feet long, or nearly 12 football fields.

This is a 2012 photograph of the Rock Knoll side of Zoar Levee. When it was originally built, the Rock Knoll had two levees as a piece of high ground bisected it. However, following raising the levee in the 1950s, the embankment was merged. Also visible is the pump station in the foreground. It was also added in the 1950s. Recently the U.S. Army Corps of Engineers upgraded the pump so it can pump 45,000 gallons per minute. It also has a new diesel generator. A $1.26 million dollar seepage blanket lines the interior of the Rock Knoll. It was placed in 2008 in response to significant under seepage that occurred.

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This is a 2012 photograph of the downstream face of Zoar Diversion Dam. Zoar Diversion Dam is located on Goose Run, about 1000 feet upstream from Zoar Levee. It is approximately 500 feet long and 35 feet high. In the foreground is a 1993 Seepage Blanket placed to help capture and control seepage that occurred through the abutment of the dam.

This is a 2012 photograph of the control tower for Zoar Diversion Dam. It is located on the upstream toe of the dam and it has a single sluice gate that can cover the 3-x-3 foot tunnel that carries Goose Run through the dam. Until the early 1990's, a permanent lake was impounded behind Zoar Diversion Dam. This lake partially drained itself through seepage on one of the abutments. Following some remedial actions, including the installation of the gravel blanket pictured above, it was recommended that the lake be permanently drained.

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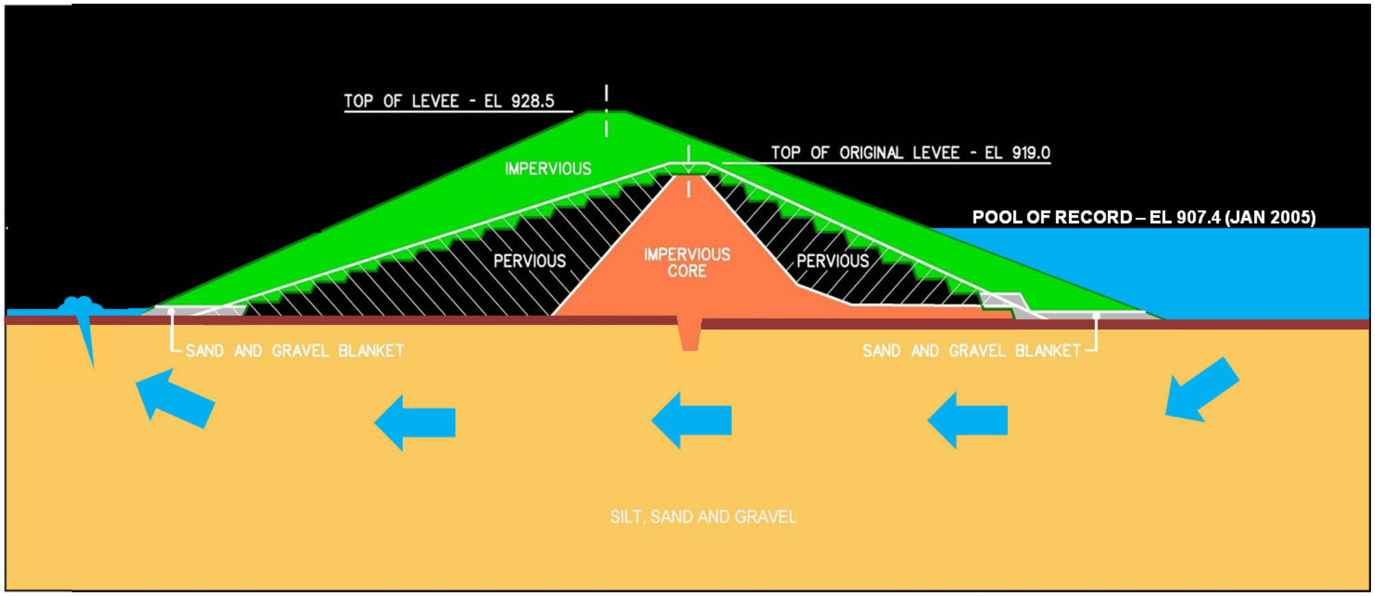
Zoar Levee has recently handled two loadings from which significant performance issues were observed.



Below is a cross section of Zoar Levee demonstrating how water being impounded on the outside of the levee (right side) moves underneath the levee. This is called "under seepage". Because Zoar Levee is founded on sands, gravels and fractured bedrock, this under seepage can lead to erosion of foundation materials if the right conditions exist.

The level of water displayed above (elevation 907.4 feet) corresponds to the highest amount of water Zoar Levee has had to hold back to date. This was the "Pool of Record" for Dover Dam. This event occurred in January of 2005 and caused under seepage. The U.S. Army Corps of Engineers, Huntington District was able to manage this seepage using sandbags.

In March of 2008, Dover Dam held a pool of water to elevation 904.6 feet which caused under seepage at Zoar Levee that led to much larger boils opening up. The largest boils occurred on the Rock Knoll, which continued to grow in size despite placing sandbags around them. In response to this event, the U.S. Army Corps of Engineers, Huntington District took emergency action by adding a large stone blanket that could help stabilize any eroding foundation material that might have been exiting the boils.

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This a photograph of standing water on interior side of the Ball Field at Zoar Levee January 2005. This was evidence of under seepage occurring.

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This is a picture of a small boil forming on the interior side of Zoar Levee in January of 2005. This is called a "pin boil". These pin boils showed that seeping water was moving a small amount of soil.

Portions of the Ball Field side at Zoar Levee are paved with asphalt for parking. This is a picture of that pavement failing due saturated soil conditions and vehicular traffic in 2005.

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This is a photograph of water seeping on the interior side of the Rock Knoll at Zoar Levee in January 2005. At this location water exited directly from the ground in large volumes.

This is a photograph of mechanical equipment stuck in the saturated ground on the interior side of the Rock Knoll at Zoar Levee in January 2005.

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This is an oblique view of Zoar Levee graphically demonstrating the locations of area seepage, pin boils, and large boils on the interior of Zoar Levee in March of 2008. This photograph was taken at the peak elevation (904.6 feet) of the Tuscarawas River during this event.

As noted, the most significant problems occurred along the Rock Knoll at the same location and elevation where water was seen significantly seeping in January 2005.

The March 2008 event resulted in a pool of water that was approximately 3 feet lower than what occurred in January of 2005. The performance of Zoar Levee decreased significantly and the U.S. Army Corps of Engineers, Huntington District took emergency action.

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This is a photograph of standing water on interior side of the Ball Field at Zoar Levee March 2008. This was evidence of under seepage occurring. This condition was very similar to that observed in January of 2005.

This is a photograph of water seeping on the interior side of the Rock Knoll at Zoar Levee in March 2008. Like in January 2005, water exited directly from the ground at this location in high volumes. Unlike January 2005, large boils formed in 2008. These boils are marked by the white rings of sandbags. These sandbag rings are deployed to stabilize the boils and keep them from increasing in size.

This picture was taken on March 18, 2012.

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This is a photograph of another boil on the interior side of the Rock Knoll at Zoar Levee in March 2008. The amount of sandbagging employed was increased as boils continued to grow in diameter.

This photo was taken on March 20, 2012.

This is a photograph of boils on the interior side of the Rock Knoll at Zoar Levee in March 2008. Despite attempts to control the growing size of boils with sandbag rings, boils continued to expand rapidly, eventually coalescing into one another, forming a large seepage exit point.

This photo was taken on March 21, 2012.

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In response to the growing boils on the Rock Knoll at Zoar Levee in March of 2008, the U.S. Army Corps of Engineers took emergency action. It quickly designed and placed a $1.26 million dollar gravel blanket over these boils. This is called a seepage blanket in that it tries to block any soil moving from the boils while distributing the water. This photograph shows the beginning the placement of this blanket at night.

This is a photograph showing the seepage blanket being placed directly over the boils on the Rock Knoll at Zoar Levee in March of 2008. At first, the placed gravel was blown out by the boils, but ultimately gravel was successfully placed.

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This is a photograph of the completed gravel seepage blanket placed in March 2008. Ultimately, approximately 6 feet of gravel was placed over the interior of the Rock Knoll at Zoar Levee.

Following the March 2008 event, the U.S. Army Corps of Engineers, Huntington District took several measures to help reduce the risk under seepage might be causing. This is a photograph of the installation of a $1.8 million seepage and drainage collection system which was installed to collect under seepage and drain it to the pump station where it can be pumped back out to the Tuscarawas River. Other measures included rehabilitating existing relief wells, or wells that relieve seepage, stock piling gravel and sandbags for future events, upgrading and automating the pump station, and establishing evaluation and surveillance pools.

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Zoar Diversion Dam has also had past performance issues.

This is a photograph looking from the diversion dam toward the downstream area during remedial work in 1978. A drainage system was added to safely control seepage exiting the face of the dam. Several other repairs were performed, including cutting a new outlet channel.

This is a photograph of Zoar Diversion Dam in 1991 when it still impounded a permanent lake.

This lake was commonly referred to as Lime Kiln or Goose Run Lake. The lake was permanently impounded to elevation 916'. The control tower can be seen in the middle ground.

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This is a photograph of a boil located downstream of Zoar Diversion Dam that was resulting from the seepage. This seepage was traveling through the bedrock that the diversion dam abuts. This is referred to as "abutment seepage". This abutment seepage partially drained the permanent impoundment from elevation 916' to elevation 906'.

This is a photograph from the crest of the Zoar Diversion Dam looking downstream. Goose Run can be seen exiting at the toe of the dam. The black arrow is highlighting the location were seepage was occurring.

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A seepage blanket was placed on downstream of the Zoar Diversion Dam to collect and manage the seepage that was occurring. This is a photograph of a geo-textile filter fabric being placed before gravel blanket was placed on top of it.

This is another photograph of the construction of the downstream seepage blanket on the Zoar Diversion Dam.

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This is photograph looking downstream from the crest of Zoar Diversion Dam in 2012 showing the completed downstream seepage blanket.

In addition to downstream treatment, in 1993 Lime Kiln or Goose Run Lake was drained. Zoar Diversion Dam can be seen in the background.

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In 1993, a portion of the upstream abutment of the dam was covered with an impervious surface. This is a photograph of that installation. It is taken from the crest of the diversion dam looking upstream.

Today, Lime Kiln or Goose Run Lake remains dry. However, flashy storm events have impounded the lake without warning and with the control gate open. This is a photograph of the dry bed of Lime Kiln or Goose Run Lake in 2012. The photograph is taken from the crest of Zoar Diversion Dam.

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In 2012, the U.S. Army Corps of Engineers, Huntington District installed a data logger to alert Government staff is water is impounded behind the Zoar Diversion Dam so its performance can be monitored.

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